Contact Transfer of Anions from Hands as a Function of the Use of Hand Lotions

by

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Abstract - Contact transfer of anions from human hands can result in contamination of materials, increasing their rate of corrosion. Two types of hand lotion were applied to the hands: one was specially formulated for cleanroom use and the other was a popular commercial lotion. The effect on contact transfer of anions was measured versus anion transfer from washed hands without lotions.

I. Introduction

Much has been said and written about gloves for use in the static protected or the contamination controlled work place. Baumgartner [1] gave an excellent overview of the subject, but presented little discussion of test methods or test results. A more recent series of papers by Welker discussed test methods [2] and contamination performance for gloves and [3] and discharge time performance of gloves and glove liners [4]. However, none of these papers discussed the influence of the use of hand lotions either on ESD or the amount of contamination that could be transferred from the hands of a lotion user to other surfaces.

II. Background and Problem

Ordinary moisturizing hand lotions can be a source of damaging contamination for aerospace products as well as semiconductors, disk drives and other contamination sensitive products. This problem was recognized at Jet Propulsion Laboratory and, as a consequence, the use of conductive hand lotions was forbidden at JPL [5]. The primary concern was contact transfer of anions from the moisturized hands, which would promote corrosion failures.

Personnel working in ESD protected work areas still suffer from dry skin. As a consequence, as much as 10 % of the personnel entering an ESD protected work area may have skin that is so dry that it interferes with proper grounding through the wrist strap [6]. People experiencing dry skin will use commercial hand lotions outside of the work place. This poses an unacceptable risk, as the composition of commercial hand lotions is unlikely to be compatible with clean room requirements, and thus represents an uncontrolled contamination exposure. It would be better to allow for the controlled use of an approved hand lotion than to tolerate the presence of uncontrolled material on peoples hands as they enter the work place.

This problem was recognized and a low contamination potential hand lotion was developed. This low contamination hand lotion was designed with several features:

- No dyes
- No fragrances
- No organics, such as lanolin, glycerin, mineral oil, or silicones, typically used in hand lotions
- Low extractable ionic content

Typical values for water extractable ions from this formulation are less than 100 ppm, according to the manufacturers literature. Anion chromatography was performed to verify these claims.

Analysis of the product does not indicate how it will perform in use. Does the product increase the amount of contact transferrable anionic contamination from the hands versus hands left untreated? And how does this compare with one of

the most popular brands of over-the-counter hand lotions: is it the same or less?

II. Experimental

Contact Transfer Sample Preparation

Three types of samples are required to determine the possible contribution of the hand lotion to anionic contamination. These samples are as follows:

1. Bare hands, after rinsing in running tap water and dried with a conventional paper towel.
2. No.1, after application of cleanroom hand lotion. A volume of lotion approximately that of a nickel was applied to the palm of one hand and the hands were rubbed together until the feel of the lotion either disappeared or no longer changed.
3. No.1, after application of a popular, commercial hand lotion. A volume of lotion approximately that of a nickel was applied to the palm of one hand and the hands were rubbed together until the feel of the lotion either disappeared or no longer changed.

A minimum of four different subjects were tested to produce the required samples.

Subjects were instructed to wash their hands under running tap water and to dry using a paper towel. The middle three fingers of one hand were then wiped on the inside walls of a clean, dry 250 ml beaker making two traverses of the beaker circumference. This is considered a bare hand control, to establish the amount of contact transferrable anionic contamination from washed, but not treated hands.

Subjects then applied one of the two hand lotions. The three middle fingers of the opposite hand were then applied to the inside wall of a second clean, dry beaker. These samples were labeled with the subject and sample lotion.

On a separate day, subjects repeated the above procedure, generating a second bare hand control and the alternate hand lotion.

The inside walls of the beakers were then rinsed repeatedly with 10 ml of ultrapure deionized water. Samples are to be analyzed using anion chromatography.

Bulk Lotion Sample Analysis

The lotions were analyzed by weighing approximately 0.1 g. into a 250 ml Erlenmeyer flask to which was added 250 ml of ultrapure deionized water. The flasks were sonicated for approximately 15 minutes. A sample of the lotion was then filtered through a 0.45 micrometer pore size PVDF filter prior to IC analysis

IC Analysis

Samples were analyzed using a Dionex Ion Chromatograph consisting of a GP40 gradient pump and CD20 conductivity detector operating at 50 mV. Separation was accomplished on a Dionex Ion Pac ™ AS4A-SC column preceded by an Ion Pac ™ AG4A-SC guard column using 0.1 mM Na_2CO_3/0.1 mM $NaHCO_3$ eluent at 2.00 ml/min flow rate. Fifty µl of sample was injected. The instrument was calibrated for fluoride, chloride, nitrate , phosphate and sulfate each time a batch of samples was run.

The resulting contact transferred anion concentrations were reported in mg per liter and converted to $\mu g/cm^2$, assuming the contact area inside the 250 ml beaker was a cylinder 6 cm in diameter by 8 cm high, ~151 cm^2.

Anion concentrations for the lotion samples were multiplied by the dilution factor and are reported in mg/l.

III. Results and Discussion

The contact transferred anions from untreated, washed hands was subtracted from the transferred anions from each of the lotions. A positive number indicates more anions were transferred after the use of the lotion versus bare washed hands. A negative number indicates less anions were transferred after

the use of the lotion versus bare washed hands. Table 1 summarizes the results.

Table 1. Change in contact transfer of anions, in micrograms per square centimeter, after using either cleanroom hand lotion or commercial hand lotion, versus bare washed hands, $\mu g/cm^2$.

Lotion Type	Fluoride	Chloride	Nitrate	Sulfate
Cleanroom	-0.019	-0.066	-0.011	-0.003
Commercial	+0.003	+0.004	+0.003	+0.001

It would appear that the cleanroom hand lotion imparts a 'barrier' effect. This may be due to dilution of anions in the skin of the subjects, due to transport of the anions away from the surface of the skin, or due to some other phenomenon. As a result of this 'barrier' effect, there is a reduction of contact transfer of anions due to the use of the cleanroom hand lotion. Conversely, use of the commercial results in an increase in contact transfer of anions. This result is consistent with our expectations: a lotion that has not been formulated specifically for clean room applications should result in an increase in contact transfer of anions to surfaces handled after application of the hand lotion. However, the reduction in contact transfer after the use of the hand lotion especially formulated for cleanroom use was not expected and is a welcome result.

This result demonstrates that the risk of contamination in the cleanroom due to the use of hand lotions can be controlled by proper selection of hand lotion.

IV. Conclusions

The use of a hand lotion formulated for use in the cleanroom is found to reduce the amount of contact transfer of anions from the skin. Conversely, the use a of a popular commercial hand lotion which is not specifically formulated for use in cleanroom applications increases the amount of contact transferred anions.

V. References

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